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(54) DISTRIBUTION PIPE ASSEMBLY FOR HEAT EXCHANGER, HEADER ASSEMBLY HAVING SAME, AND HEAT EXCHANGER

(57) The embodiments of the present invention provide a distribution pipe assembly for a heat exchanger, a header assembly having the distribution pipe assembly, and a heat exchanger. The distribution pipe assembly comprises a first distribution pipe comprising: a main body wall part, extending in a first direction that is an axial direction, and having a first side in a second direction perpendicular to the first direction and a second side in the second direction, the second side being opposite the first side; and a protruding wall part that protrudes from the main body wall part in the second direction. The distribution pipe assembly and heat exchanger according to embodiments of the present invention can for example improve the heat exchange performance of the heat exchanger.

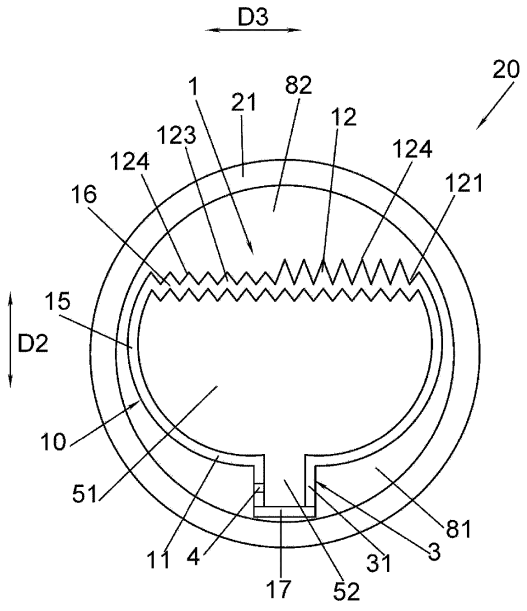

Fig.1

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Description

Cross-reference to related application

[0001] The present application claims the rights of Chinese patent application no. 201811120743.7 submitted to the Chinese Patent Office on September 25, 2018, the entire published contents of which are incorporated herein by reference.

Technical field

[0002] The embodiments of the present invention relate to a distribution pipe assembly for a heat exchanger, a header assembly having the distribution pipe assembly, and a heat exchanger.

Background of the invention

[0003] A heat exchanger such as a micro-channel heat exchanger comprises: fins, heat exchange tubes arranged between adjacent fins, headers, and distribution pipes arranged in the headers, wherein the heat exchange tubes can be flat tubes.

Summary of the invention

[0004] An object of the embodiments of the present invention is to provide a distribution pipe assembly for a heat exchanger, a header assembly having the distribution pipe assembly, and a heat exchanger, in order to improve for example the heat exchange performance of the heat exchanger.

[0005] An embodiment of the present disclosure provides a distribution pipe assembly for a heat exchanger, comprising: a first distribution pipe, wherein the first distribution pipe comprises: a main body wall part, extending in a first direction that is an axial direction, and having a first side in a second direction perpendicular to the first direction and a second side in the second direction, the second side being opposite the first side; and a protruding wall part that protrudes from the main body wall part in the second direction.

[0006] According to an embodiment of the present disclosure, the protruding wall part protrudes in the second direction from the first side of the main body wall part.

[0007] According to an embodiment of the present disclosure, the protruding wall part protrudes inward in the second direction from the second side of the main body wall part.

[0008] According to an embodiment of the present disclosure, the first distribution pipe further comprises: a distribution hole, formed in the protruding wall part and configured to distribute a refrigerant.

[0009] According to an embodiment of the present disclosure, the protruding wall part has a side wall part facing in a third direction perpendicular to the first direction and second direction.

[0010] According to an embodiment of the present disclosure, the distribution hole is formed in the side wall part, or a gap between two said side wall parts forms the distribution hole, the gap being at the second side of the main body wall part in the second direction.

[0011] According to an embodiment of the present disclosure, the main body wall part has a surface at the second side; and
the distribution pipe assembly further comprises two protrusions protruding outward in the second direction from the surface at the second side of the main body wall part, the two protrusions being formed on two edges, in a third direction perpendicular to the first direction and second direction, of the flat surface respectively.

[0012] According to an embodiment of the present disclosure, the main body wall part has a corrugated wall part at the second side, the corrugated wall part having crests that protrude outward in the second direction, the tops of the crests substantially being in the same plane; or the main body wall part has a corrugated wall part at the second side, the corrugated wall part having crests that protrude outward in the second direction, and the height of the top of the crest at one side of the corrugated wall part in the third direction is less than the height of the top of the crest at the other side of the corrugated wall part in the third direction.

[0013] According to an embodiment of the present disclosure, the protruding wall part protrudes outward in the second direction from the first side of the main body wall part; and the main body wall part defines a first cavity part, the protruding wall part defines a second cavity part, and the first cavity part is in communication with the second cavity part.

[0014] According to an embodiment of the present disclosure, the protruding wall part protrudes inward in the second direction from the first side of the main body wall part, and forms a recess in the main body wall part.

[0015] According to an embodiment of the present disclosure, a first connection point of the protruding wall part and the main body wall part at one side in a third direction perpendicular to the first direction and second direction, and a second connection point of the protruding wall part and the main body wall part at the other side in the third direction, are located at different positions in the second direction.

[0016] According to an embodiment of the present disclosure, the protruding wall part has a first edge part at a first side in the second direction, and has a second edge part at a second side in the second direction, the second side being opposite the first side; the main body wall part has a first edge part and a second edge part at the first side in the second direction, and the second edge part is closer, in the second direction, to the second side of the main body wall part in the second direction than the first edge part is; and the first edge part of the main body wall part is connected to the first edge part of the protruding wall part, and the second edge part of the main body wall part is connected to the second edge part of

the protruding wall part.

[0017] According to an embodiment of the present disclosure, the first distribution pipe further comprises: an extension part extending inward from the second edge part of the main body wall part in a third direction perpendicular to the first direction and second direction.

[0018] According to an embodiment of the present disclosure, the protruding wall part protrudes inward in the second direction from the second side of the main body wall part; and an inner wall of the main body wall part and an outer wall of the protruding wall part define a first cavity part, an inner wall of the protruding wall part defines a second cavity part, and the first cavity part and the second cavity part are in communication with each other at the first side of the main body wall part in the second direction.

[0019] According to an embodiment of the present disclosure, the protruding wall part has a first edge part at a first side in the second direction, and has a second edge part at a second side in the second direction, the second side being opposite the first side; the first edge part of the protruding wall part is connected to the first side of the main body wall part, and the second edge part of the protruding wall part is connected to the second side of the main body wall part.

[0020] According to an embodiment of the present disclosure, a distribution hole, formed at the first side of the main body wall part and configured to distribute a refrigerant.

[0021] According to an embodiment of the present disclosure, the protruding wall part has two side wall parts facing in a third direction perpendicular to the first direction and second direction, each of the two side wall parts having a first edge part at a first side in the second direction, and having a second edge part at a second side in the second direction, the second side being opposite the first side; the first edge part of at least one of the two side wall parts is connected to or spaced apart from the first side of the main body wall part, and the second edge part of each of the two side wall parts is connected to the second side of the main body wall part.

[0022] According to an embodiment of the present disclosure, the protruding wall part has the shape of a long strip and extends substantially in the first direction.

[0023] According to an embodiment of the present disclosure, a second distribution pipe is inserted in the first distribution pipe and has a distribution hole.

[0024] According to an embodiment of the present disclosure, the volume of the second cavity part is 1 % - 30% of the sum of the volume of the first cavity part and the volume of the second cavity part.

[0025] An embodiment of the present disclosure further provides a header assembly, comprising: a header; and the distribution pipe assembly described above, disposed in the header.

[0026] According to an embodiment of the present disclosure, the header comprises an end cap, the header assembly further comprising: a first connecting part disposed on an end of the first distribution pipe or the distribution pipe assembly; and a second connecting part disposed on the end cap of the header, the first connecting part being connected to the second connecting part so as to fix the distribution pipe assembly in the header.

[0027] According to an embodiment of the present disclosure, the first connecting part disposed on the end of the first distribution pipe or the distribution pipe assembly is a protrusion; the second connecting part disposed on the end cap of the header is an opening or slot, and the protrusion is inserted into the opening or slot.

[0028] According to an embodiment of the present disclosure, the protrusion protrudes from an end of the protruding wall part.

[0029] An embodiment of the present disclosure further provides a heat exchanger, comprising: a header; and the distribution pipe assembly described above, disposed in the header.

[0030] The distribution pipe assembly and heat exchanger according to the present invention can for example improve the heat exchange performance of the heat exchanger.

Brief description of the drawings

[0031]

Fig. 1 is a schematic sectional view of the header assembly according to a first embodiment of the present invention.

Fig. 2 is a schematic sectional view of the header assembly according to a second embodiment of the present invention.

Fig. 3 is a schematic sectional view of the header assembly according to a third embodiment of the present invention.

Fig. 4 is a schematic sectional view of the header assembly according to a fourth embodiment of the present invention.

Fig. 5 is a schematic sectional view of the header assembly according to a fifth embodiment of the present invention.

Fig. 6 is a schematic sectional view of the header assembly according to a sixth embodiment of the present invention.

Fig. 7 is a schematic sectional view of the header assembly according to a seventh embodiment of the present invention.

Fig. 8 is a schematic sectional view of the header assembly according to an eighth embodiment of the present invention.

Fig. 9 is a schematic sectional view of the header assembly according to a ninth embodiment of the present invention.

Fig. 10 is a schematic sectional view of the header assembly according to a tenth embodiment of the present invention.

Fig. 11 is a schematic sectional view of the header

assembly according to an eleventh embodiment of the present invention.

Fig. 12 is a schematic three-dimensional view of the distribution pipe assembly according to an embodiment of the present invention.

Fig. 13 is a schematic three-dimensional view of the header assembly according to a twelfth embodiment of the present invention.

Fig. 14 is an enlarged view of part A of the header assembly shown in Fig. 13.

Fig. 15 is a schematic three-dimensional view of the heat exchanger according to an embodiment of the present invention.

Fig. 16 is a schematic partially sectional three-dimensional view of the heat exchanger according to an embodiment of the present invention.

Fig. 17 is an enlarged view of part B of the heat exchanger shown in Fig. 16.

Fig. 18 is another schematic partially sectional three-dimensional view of the heat exchanger according to an embodiment of the present invention; and

Fig. 19 is an enlarged view of part C of the heat exchanger shown in Fig. 18.

Detailed description of the invention

[0032] The present invention is explained further below in conjunction with the drawings and particular embodiments.

[0033] Referring to Figs. 1 - 19, a header assembly 20 according to an embodiment of the present invention comprises: a header 21; and a distribution pipe assembly 1 arranged in the header 21. The distribution pipe assembly 1 may not come into contact with an inner wall of the header 21; for example, a protrusion 17 is formed on an end face of the distribution pipe assembly 1, an opening or slot 24 is formed in an end cap 23 of the header 21, and the distribution pipe assembly 1 is installed by inserting the protrusion 17 on the end face of the distribution pipe assembly 1 into the opening or slot 24 in the end cap 23 of the header 21.

[0034] Referring to Figs. 1 - 19, a heat exchanger 100 according to an embodiment of the present invention comprises: a header 21; and a distribution pipe assembly 1 arranged in the header 21. The heat exchanger 100 further comprises heat exchange tubes 9 and fins 91.

[0035] Referring to Figs. 1 - 14, a distribution pipe assembly 1 according to an embodiment of the present invention comprises a first distribution pipe. The first distribution pipe comprises: a main body wall part 10, extending in a first direction D1 that is an axial direction, and having a first side 11 in a second direction D2 perpendicular to the first direction D1 and a second side 12 in the second direction D2, the second side being opposite the first side 11; and a protruding wall part 3 that protrudes from the main body wall part 10 in the second direction D2. The second direction D2 may be a vertical direction. The protruding wall part 3 has the shape of a long strip and extends substantially in the first direction. Optionally, the protruding wall part 3 may be multiple discrete protruding wall parts arranged in the first direction.

[0036] Referring to Figs. 1 - 8, in an embodiment of the present invention, the protruding wall part 3 protrudes from the first side 11 of the main body wall part 10 in the second direction D2. The first distribution pipe further comprises a distribution hole 4, formed in the protruding wall part 3 and configured to distribute a refrigerant. Optionally, referring to Figs. 9 - 11, in an embodiment of the present invention, the protruding wall part 3 protrudes inward in the second direction D2 from the second side 12 of the main body wall part 10. The distribution pipe assembly 1 further comprises: a distribution hole 4, formed in the protruding wall part 3 and configured to distribute a refrigerant. Referring to Figs. 1 - 14, in an embodiment of the present invention, in a third direction D3 perpendicular to the first direction D1 and second direction D2, the maximum size of the protruding wall part 3 is less than or equal to half of the maximum size of the main body wall part 10. The third direction D3 may be a horizontal direction.

[0037] Referring to Figs. 1 - 14, in an embodiment of the present invention, the protruding wall part 3 has a side wall part 31 facing in the third direction D3 perpendicular to the first direction D1 and second direction D2. Referring to Figs. 1 - 8, in an embodiment of the present invention, the distribution hole 4 is formed in the side wall part 31. As shown in Figs. 1 - 14, the protruding wall part 3 has two side wall parts 31 facing in the third direction D3 perpendicular to the first direction D1 and second direction D2. In one example of the present invention, as shown in Figs. 1 - 8, the distribution hole 4 is formed in at least one of the two side wall parts 31. In one example of the present invention, referring to Figs. 9 - 11, the distribution hole 4 is formed between the two side wall parts 31, and is located at the second side 12 of the main body wall part 10 in the second direction D2.

[0038] Referring to Fig. 2, in an embodiment of the present invention, the main body wall part 10 has a surface 121 (e.g. a flat surface) at the second side 12; and the first distribution pipe further comprises two protrusions 122 protruding outward from the surface 121 in the second direction D2, the two protrusions 122 being formed on two edges, in the third direction D3 perpendicular to the first direction D1 and second direction D2, of the surface 121 respectively.

[0039] Referring to Fig. 1, in an embodiment of the present invention, the main body wall part 10 has a surface 121 (e.g. a flat surface) at the second side 12; and the first distribution pipe further comprises multiple protrusions protruding outward from the surface 121 in the second direction D2, the height of a protrusion on the surface 121 at one side in the third direction D3 being less than the height of a protrusion on the surface 121 at the other side in the third direction D3.

[0040] Referring to Fig. 1, in another embodiment of the present invention, in one embodiment of the present

invention, the main body wall part 10 has a corrugated wall part 123 at the second side 12, the corrugated wall part 123 having crests 124 that protrude outward in the second direction D2, the tops of the crests 124 substantially being in the same plane. Referring to Fig. 1, in another embodiment of the present invention, the main body wall part 10 has a corrugated wall part 123 at the second side, the corrugated wall part 123 having crests 124 that protrude outward in the second direction D2, and the height of the top of the crest 124 at one side of the corrugated wall part 123 in the third direction D3 is less than the height of the top of the crest 124 at the other side of the corrugated wall part 123 in the third direction D3. For example, the heights of the tops of crests 124 on the corrugated wall part 123 at one side in the third direction D3 are the same, and the heights of the tops of crests 124 on the corrugated wall part 123 at the other side in the third direction D3 are the same.

[0041] Referring to Figs. 1 - 14, in an embodiment of the present invention, the shape of the protrusion may be rectangular, trapezoidal, triangular or round, etc. An alternately sunken and protruding part formed by the protrusions is configured to store a refrigerant gas-liquid mixture.

[0042] Referring to Figs. 1 - 5, in an embodiment of the present invention, the protruding wall part 3 protrudes outward in the second direction D2 from the first side 11 of the main body wall part 10; moreover, the main body wall part 10 defines a first cavity part 51, the protruding wall part 3 defines a second cavity part 52, and the first cavity part 51 is in communication with the second cavity part 52. The second cavity part 52 defined by the protruding wall part 3 can have any shape, e.g. rectangular, trapezoidal, triangular or round, etc. In use, the second cavity part 52 defined by the protruding wall part 3 may be substantially located at the bottom of the distribution pipe assembly 1. The volume of the second cavity part 52 is less than the volume of the first cavity part 51; for example, the volume of the second cavity part 52 is 1% - 30% of the sum of the volume of the first cavity part 51 and the volume of the second cavity part 52.

[0043] Referring to Figs. 6 - 8, in an embodiment of the present invention, the protruding wall part 3 protrudes inward in the second direction D2 from the first side 11 of the main body wall part 10, and forms a recess 53 on the main body wall part 10. As shown in Fig. 6, a first connection point 61 of the protruding wall part 3 and the main body wall part 10 at one side in the third direction D3 perpendicular to the first direction D1 and second direction D2, and a second connection point 62 of the protruding wall part 3 and the main body wall part 10 at the other side in the third direction D3, are located at different positions in the second direction D2. As shown in Fig. 8, the protruding wall part 3 has a first edge part 311 at a first side in the second direction D2, and has a second edge part 312 at a second side in the second direction D2, the second side being opposite the first side. The main body wall part 10 has a first edge part 101 and a second edge part 102 at the first side 11 in the second direction D2; and the second edge part 102 is closer, in the second direction D2, to the second side 12 of the main body wall part 10 in the second direction D2 than the first edge part 101 is. Moreover, the first edge part 101 of the main body wall part 10 is connected to the first edge part 311 of the protruding wall part 3, and the second edge part 102 of the main body wall part 10 is connected to the second edge part 312 of the protruding wall part 3. The distribution pipe assembly 1 may further comprise: an extension part 103 extending inward from the second edge part 102 of the main body wall part 10 in the third direction D3 perpendicular to the first direction D1 and second direction D2.

[0044] Referring to Figs. 9 - 10, in an embodiment of the present invention, the protruding wall part 3 protrudes inward in the second direction D2 from the second side 12 of the main body wall part 10; moreover, an inner wall of the main body wall part 10 and an outer wall of the protruding wall part 3 define a first cavity part 51, a second cavity part 52 is defined by an inner wall of the protruding wall part 3 (or between two protruding wall parts 3), and the first cavity part 51 and the second cavity part 52 are in communication with each other at the first side 11 of the main body wall part 10 in the second direction D2. For example, the protruding wall part 3 has two side wall parts 31 facing in the third direction D3 perpendicular to the first direction D1 and second direction D2; and a gap between the two side wall parts 31 forms the distribution hole 4, the gap being at the second side 12 of the main body wall part 10 in the second direction D2. The volume of the second cavity part 52 is less than the volume of the first cavity part 51; for example, the volume of the second cavity part 52 is 1 % - 30% of the sum of the volume of the first cavity part 51 and the volume of the second cavity part 52.

[0045] Referring to Fig. 11, in an embodiment of the present invention, the protruding wall part 3 has a first edge part 311 at a first side in the second direction D2, and has a second edge part 312 at a second side in the second direction D2, the second side being opposite the first side; the first edge part 311 of the protruding wall part 3 is connected to the first side 11 of the main body wall part 10, and the second edge part 312 of the protruding wall part 3 is connected to the second side 12 of the main body wall part 10. For example, the distribution pipe assembly 1 further comprises: a distribution hole 4, formed at the first side 11 of the main body wall part 10 and configured to distribute refrigerant.

[0046] Referring to Figs. 9 - 10, in an embodiment of the present invention, each of the two side wall parts 31 has a first edge part 311 at a first side in the second direction D2, and has a second edge part 312 at a second side in the second direction D2, the second side being opposite the first side; the first edge part 311 of at least one of the two side wall parts 31 is connected to the first side 11 of the main body wall part 10, and the second edge part 312 of each of the two side wall parts 31 is

connected to the second side 12 of the main body wall part 10. In the case where the first edge parts 311 of the two side wall parts 31 are connected to the first side 11 of the main body wall part 10, for example, the distribution pipe assembly 1 further comprises: a distribution hole 4 formed at the first side 11 of the main body wall part 10 and configured to distribute refrigerant, or an inlet formed in at least one of the two side wall parts 31 and located close to the first edge part 311; as described above, a gap between the two side wall parts 31 forms the distribution hole 4, the gap being at the second side 12 of the main body wall part 10 in the second direction D2.

[0047] Referring to Figs. 9 - 10, in an embodiment of the present invention, each of the two side wall parts 31 has a first edge part 311 at a first side in the second direction D2, and has a second edge part 312 at a second side in the second direction D2, the second side being opposite the first side; the first edge part 311 of at least one of the two side wall parts 31 is spaced apart from the first side 11 of the main body wall part 10, and the second edge part 312 of each of the two side wall parts 31 is connected to the second side 12 of the main body wall part 10.

[0048] According to an embodiment of the present invention, as shown in Fig. 9, a space formed by the main body wall part 10 and a left-side side wall 31 may not be used for refrigerant distribution, merely being configured to reduce the internal volume of the header. For example, the space formed by the main body wall part 10 and the left-side side wall 31 may be closed.

[0049] According to an embodiment of the present invention, as shown in Figs. 1 - 8, the main body wall part 10 of the distribution pipe assembly 1 has a side wall 15 and a top wall 16. In the header assembly 20, a gap between the inner wall of the header 21 and the distribution pipe assembly 1 gradually decreases from two side walls 31 of the protruding wall part 3 or from the protruding wall part 3 or from the bottom of the distribution pipe assembly 1 to a top point of the side wall 15 of the main body wall part 10. Between the inner wall of the header 21 and the distribution pipe assembly 1, a first mixing cavity 81 is formed from the two side walls 31 of the protruding wall part 3 to the top point of the side wall 15 of the main body wall part 10; a space above the top wall 16 of the distribution pipe assembly 1 forms a second mixing cavity 82. The second cavity part 52 formed by the protruding wall part 3 forms a liquid storage cavity, and the first cavity part 51 formed by the main body wall part 10 forms a separating cavity. The volume of the first cavity part 51 is greater than the volume of the second cavity part 52; the first cavity part 51 promotes gas-liquid separation of two-phase flow of refrigerant, such that isolated liquid refrigerant is stored in the second cavity part 52, enters the first mixing cavity 81 and second mixing cavity 82 via the distribution hole 4, and then enters the heat exchange tubes 9. Thus, by reducing the volume of the first mixing cavity 81 before the refrigerant enters the heat exchange tubes 9, the refrigerant is caused to enter the heat exchange tubes 9 after mixing fully in the first mixing cavity 81. The volume of the first mixing cavity 81 may be less than the volume of the second mixing cavity 82.

[0050] Referring to Fig. 4, the header 21 may be a header formed of multiple components.

[0051] Referring to Fig. 13, the header 21 is provided with slots for the heat exchange tubes to be inserted in; the second side 12 of the distribution pipe assembly 1 in the second direction D2 may be substantially opposite the slots in the header for the heat exchange tubes to be inserted in.

[0052] In the embodiments shown in Figs. 9 and 10, in the third direction D3, the two side walls 31 may be located at a middle part or at the centre of the first cavity part 51 defined by the main body wall part 10, and the two side walls 31 may extend in the second direction D2. This enables more uniform dispersion of refrigerant at the top of the main body wall part 10. An arc-shaped outer wall of the main body wall part 10 of the distribution pipe assembly 1 may be in contact with or separated from the header, or formed integrally with the header; for example, the arc-shaped outer wall of the main body wall part 10 of the distribution pipe assembly 1 may be eliminated. In addition, in the embodiments shown in Figs. 9 - 10, the second cavity part 52 defined by the protruding wall part 3 or between the two side walls 31, and a gap between the inner wall of the header 21 and the outer wall of the main body wall part 10 or the outer wall of the first distribution pipe or the distribution pipe assembly 1, form a mixing cavity; the first cavity part 51 defined by the main body wall part 10 forms a separating cavity; and liquid refrigerant is stored at the bottom of the first cavity part 51 defined by the main body wall part 10. A gap between the bottom of the main body wall part 10 and the header 21 and a gap between the side wall of the main body wall part and the header 21 may be substantially the same. In the embodiment shown in Fig. 11, a gap between the inner wall of the header 21 and the outer wall of the main body wall part 10 or the outer wall of the first distribution pipe or the distribution pipe assembly 1 forms a mixing cavity; a gap between the bottom of the main body wall part 10 and the inner wall of the header 21 and a gap between the side wall of the main body wall part and the inner wall of the header form the first mixing cavity 81 (see Fig. 1).

[0053] In the embodiments shown in Figs. 6 - 8, the first cavity part 51 defined by the main body wall part 10 forms a separating cavity, and liquid refrigerant is stored at the bottom of the first cavity part 51 defined by the main body wall part 10. The heat exchanger according to an embodiment of the present invention is simple to assemble; a refrigerant gas-liquid mixture is mixed fully before entering the heat exchange tubes, achieving uniform distribution of refrigerant to the maximum extent. The performance of the heat exchanger is improved considerably. In addition, due to the space restrictions of the mixing cavities, a minimum flow speed of refrigerant is

ensured, thereby avoiding oil accumulation. Furthermore, the internal volume of the heat exchanger using the header assembly is reduced, thereby reducing the charging amount of the entire system.

[0054] According to an embodiment of the present invention, referring to Figs. 12 - 19, the distribution pipe assembly 1 further comprises a second distribution pipe 101, the second distribution pipe 101 being inserted in the first distribution pipe and having a distribution hole. The second distribution pipe 101 may be a conventional distribution pipe; refrigerant flows into the first distribution pipe 1 from the second distribution pipe 101, and then flows into the heat exchange tubes 9.

[0055] Referring to Figs. 12 - 19, the header comprises an end cap 23, and the header assembly 1 further comprises: a first connecting part disposed on an end of the first distribution pipe or the distribution pipe assembly 1; and a second connecting part disposed on the end cap 23 of the header 21, the first connecting part being connected to the second connecting part so as to fix the distribution pipe assembly 1 in the header 21. For example, as described above, the first connecting part disposed on an end of the first distribution pipe or the distribution pipe assembly 1 is the protrusion 17; the second connecting part disposed on the end cap 23 of the header 21 is the opening or slot 24, and the protrusion 17 is inserted into the opening or slot 24. The protrusion 17 may protrude from an end or end face of the protruding wall part 3.

[0056] According to an embodiment of the present invention, referring to Figs. 1 - 8 and 11, a gap between the inner wall of the header 21 and an outer wall of the first distribution pipe or the distribution pipe assembly 1 forms a third cavity part (i.e. forms a mixing cavity, the mixing cavity comprising the first mixing cavity 81 and second mixing cavity 82); the volume or cross-sectional area of the third cavity part is less than the volume or cross-sectional area defined by an inner wall of the first distribution pipe or the distribution pipe assembly 1, and is 1/20 - 1/2 of the volume or cross-sectional area defined by the inner wall of the first distribution pipe or the distribution pipe assembly 1.

[0057] In addition, referring to Figs. 9 - 10, in an embodiment of the present invention, the second cavity part 52 and a gap between the inner wall of the header 21 and the outer wall of the first distribution pipe or the distribution pipe assembly 1 form a third cavity part (i.e. form a mixing cavity). The sum of the volume or cross-sectional area of the gap between the inner wall of the header 21 and the outer wall of the first distribution pipe or the distribution pipe assembly 1 and the volume or cross-sectional area of the second cavity part 52 is less than the volume or cross-sectional area of the first cavity part 51, and is 1/20 - 1/2 of the volume or cross-sectional area of the first cavity part 51.

[0058] In the embodiments above, the volume and cross-sectional area defined by the inner wall of the first distribution pipe or the distribution pipe assembly 1 and the volume and cross-sectional area of the second cavity part 52 do not include the volume and cross-sectional area of the space, at the left side, that is not used for refrigerant distribution as shown in Fig. 9.

[0059] Since the separating cavity is large and the mixing cavity is small, refrigerant readily separates into layers of gas and liquid after entering the separating cavity, and liquid is deposited at the bottom of the distribution pipe assembly 1 (e.g. in the protruding wall). Since the gaseous refrigerant has a high speed, it will push the liquid refrigerant to be ejected from the distribution hole; during this process, the gaseous refrigerant and liquid refrigerant mix, and then enter the mixing cavity. Since the mixing cavity has a small volume, the gaseous refrigerant and liquid refrigerant will be further mixed evenly and then enter the heat exchange tubes, thereby increasing the heat exchange efficiency of the heat exchanger.

[0060] It must be explained that some or all of the technical features in the embodiments above may be combined to form new embodiments.

Claims

1. A distribution pipe assembly for a heat exchanger, comprising:

   a first distribution pipe,
   wherein the first distribution pipe comprises:

   a main body wall part, extending in a first direction that is an axial direction, and having a first side in a second direction perpendicular to the first direction and a second side in the second direction, the second side being opposite the first side; and
   a protruding wall part that protrudes from the main body wall part in the second direction.

2. The distribution pipe assembly for a heat exchanger as claimed in claim 1, wherein:
   the protruding wall part protrudes in the second direction from the first side of the main body wall part.

3. The distribution pipe assembly for a heat exchanger as claimed in claim 1, wherein:
   the protruding wall part protrudes inward in the second direction from the second side of the main body wall part.

4. The distribution pipe assembly for a heat exchanger as claimed in claim 2 or 3, wherein the first distribution pipe further comprises:
   a distribution hole, formed in the protruding wall part and configured to distribute a refrigerant.

5. The distribution pipe assembly for a heat exchanger

as claimed in claim 4, wherein:
the protruding wall part has a side wall part facing in a third direction perpendicular to the first direction and second direction.

6. The distribution pipe assembly for a heat exchanger as claimed in claim 5, wherein:
the distribution hole is formed in the side wall part, or a gap between two said side wall parts forms the distribution hole, the gap being at the second side of the main body wall part in the second direction.

7. The distribution pipe assembly for a heat exchanger as claimed in claim 2 or 3, wherein:

the main body wall part has a surface at the second side; and
the distribution pipe assembly further comprises two protrusions protruding outward in the second direction from the surface at the second side of the main body wall part, the two protrusions being formed on two edges, in a third direction perpendicular to the first direction and second direction, of the flat surface respectively.

8. The distribution pipe assembly for a heat exchanger as claimed in claim 2 or 3, wherein:

the main body wall part has a corrugated wall part at the second side, the corrugated wall part having crests that protrude outward in the second direction, the tops of the crests substantially being in the same plane; or
the main body wall part has a corrugated wall part at the second side, the corrugated wall part having crests that protrude outward in the second direction, and the height of the top of the crest at one side of the corrugated wall part in the third direction is less than the height of the top of the crest at the other side of the corrugated wall part in the third direction.

9. The distribution pipe assembly for a heat exchanger as claimed in claim 2, wherein:

the protruding wall part protrudes outward in the second direction from the first side of the main body wall part; and
the main body wall part defines a first cavity part, the protruding wall part defines a second cavity part, and the first cavity part is in communication with the second cavity part.

10. The distribution pipe assembly for a heat exchanger as claimed in claim 2, wherein:
the protruding wall part protrudes inward in the second direction from the first side of the main body wall part, and forms a recess in the main body wall part.

11. The distribution pipe assembly for a heat exchanger as claimed in claim 10, wherein:
a first connection point of the protruding wall part and the main body wall part at one side in a third direction perpendicular to the first direction and second direction, and a second connection point of the protruding wall part and the main body wall part at the other side in the third direction, are located at different positions in the second direction.

12. The distribution pipe assembly for a heat exchanger as claimed in claim 10, wherein:

the protruding wall part has a first edge part at a first side in the second direction, and has a second edge part at a second side in the second direction, the second side being opposite the first side;
the main body wall part has a first edge part and a second edge part at the first side in the second direction, and the second edge part is closer, in the second direction, to the second side of the main body wall part in the second direction than the first edge part is; and
the first edge part of the main body wall part is connected to the first edge part of the protruding wall part, and the second edge part of the main body wall part is connected to the second edge part of the protruding wall part.

13. The distribution pipe assembly for a heat exchanger as claimed in claim 12, wherein the first distribution pipe further comprises:
an extension part extending inward from the second edge part of the main body wall part in a third direction perpendicular to the first direction and second direction.

14. The distribution pipe assembly for a heat exchanger as claimed in claim 3, wherein:

the protruding wall part protrudes inward in the second direction from the second side of the main body wall part; and
an inner wall of the main body wall part and an outer wall of the protruding wall part define a first cavity part, an inner wall of the protruding wall part defines a second cavity part, and the first cavity part and the second cavity part are in communication with each other at the first side of the main body wall part in the second direction.

15. The distribution pipe assembly for a heat exchanger as claimed in claim 3, wherein:
the protruding wall part has a first edge part at a first side in the second direction, and has a second edge part at a second side in the second direction, the second side being opposite the first side; the first

edge part of the protruding wall part is connected to the first side of the main body wall part, and the second edge part of the protruding wall part is connected to the second side of the main body wall part.

16. The distribution pipe assembly for a heat exchanger as claimed in claim 15, wherein the first distribution pipe further comprises:
a distribution hole, formed at the first side of the main body wall part and configured to distribute a refrigerant.

17. The distribution pipe assembly for a heat exchanger as claimed in claim 14, wherein:
the protruding wall part has two side wall parts facing in a third direction perpendicular to the first direction and second direction, each of the two side wall parts having a first edge part at a first side in the second direction, and having a second edge part at a second side in the second direction, the second side being opposite the first side; the first edge part of at least one of the two side wall parts is connected to or spaced apart from the first side of the main body wall part, and the second edge part of each of the two side wall parts is connected to the second side of the main body wall part.

18. The distribution pipe assembly for a heat exchanger as claimed in claim 1, wherein:
the protruding wall part has the shape of a long strip and extends substantially in the first direction.

19. The distribution pipe assembly for a heat exchanger as claimed in claim 1, further comprising:
a second distribution pipe, the second distribution pipe being inserted in the first distribution pipe and having a distribution hole.

20. The distribution pipe assembly for a heat exchanger as claimed in claim 9 or 14, wherein:
the volume of the second cavity part is 1% - 30% of the sum of the volume of the first cavity part and the volume of the second cavity part.

21. A header assembly, comprising:

a header; and
the distribution pipe assembly as claimed in claim 1, disposed in the header.

22. The header assembly as claimed in claim 21, wherein:

the header comprises an end cap,
the header assembly further comprising:

a first connecting part disposed on an end of the first distribution pipe or the distribution pipe assembly; and
a second connecting part disposed on the end cap of the header, the first connecting part being connected to the second connecting part so as to fix the distribution pipe assembly in the header.

23. The header assembly as claimed in claim 22, wherein:

the first connecting part disposed on the end of the first distribution pipe or the distribution pipe assembly is a protrusion;
the second connecting part disposed on the end cap of the header is an opening or slot, and the protrusion is inserted into the opening or slot.

24. The header assembly as claimed in claim 23, wherein:
the protrusion protrudes from an end of the protruding wall part.

25. A heat exchanger, comprising:

a header; and
the distribution pipe assembly as claimed in claim 1, disposed in the header.

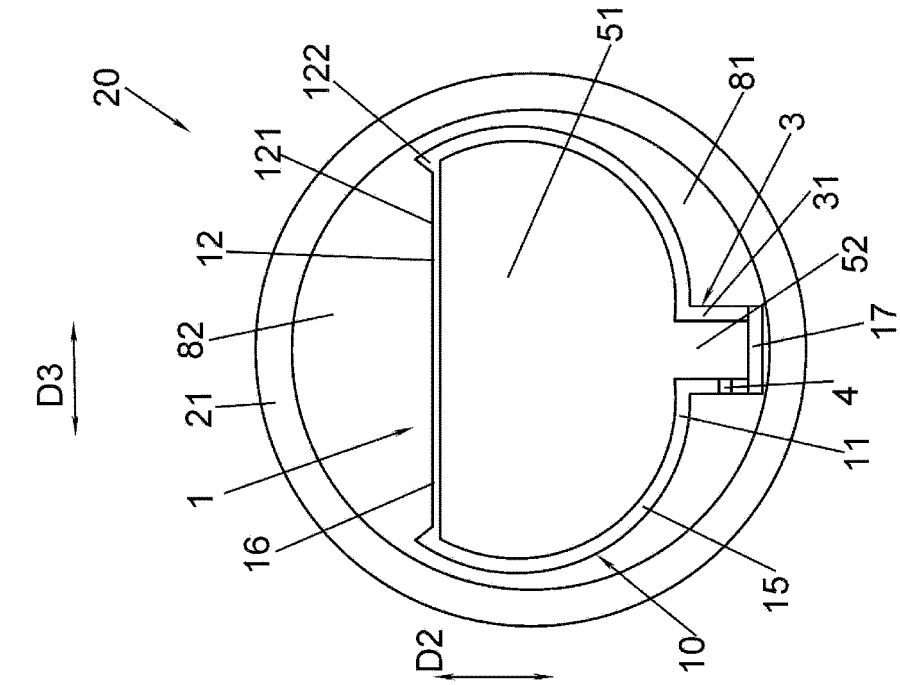
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Fig.2

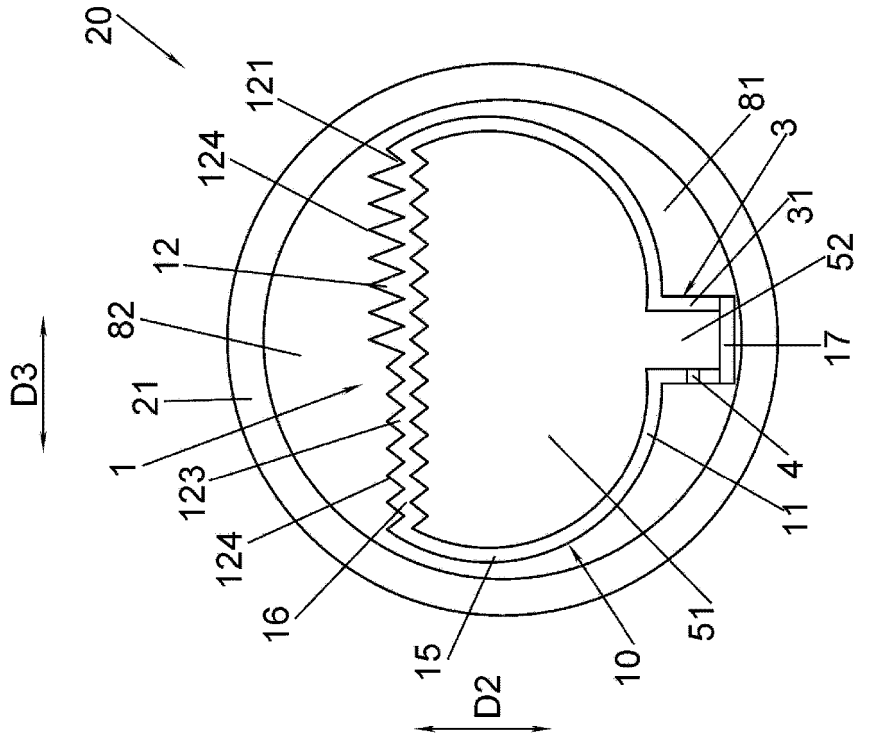
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Fig.1

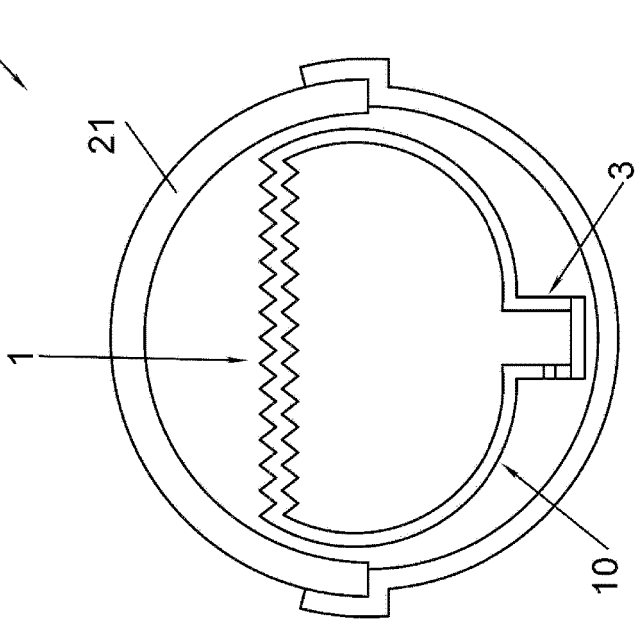
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Fig.4

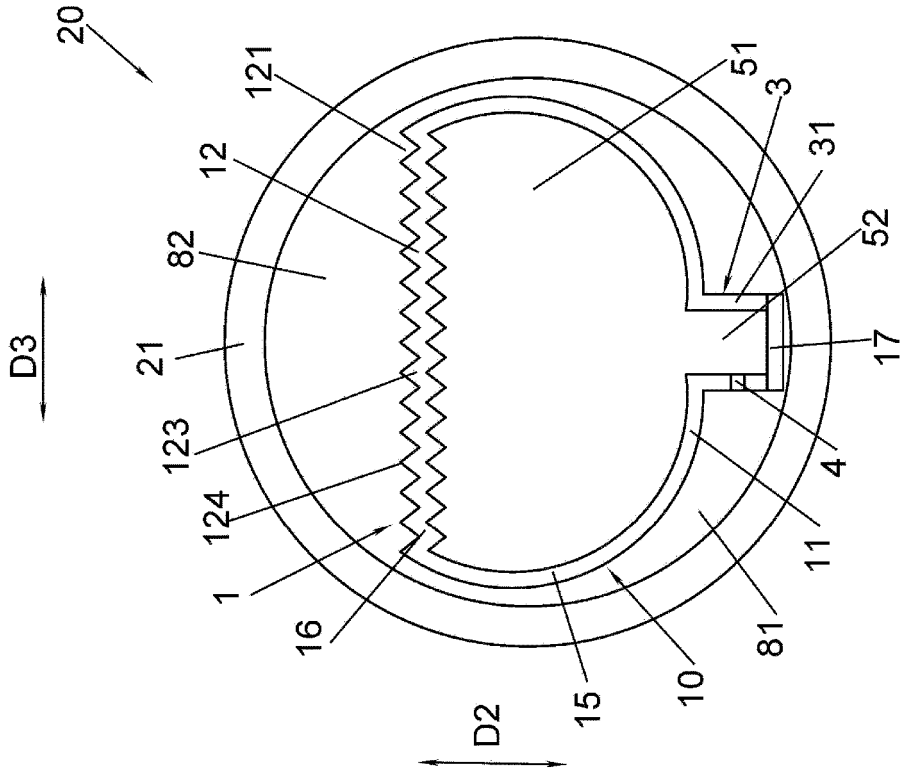
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Fig.3

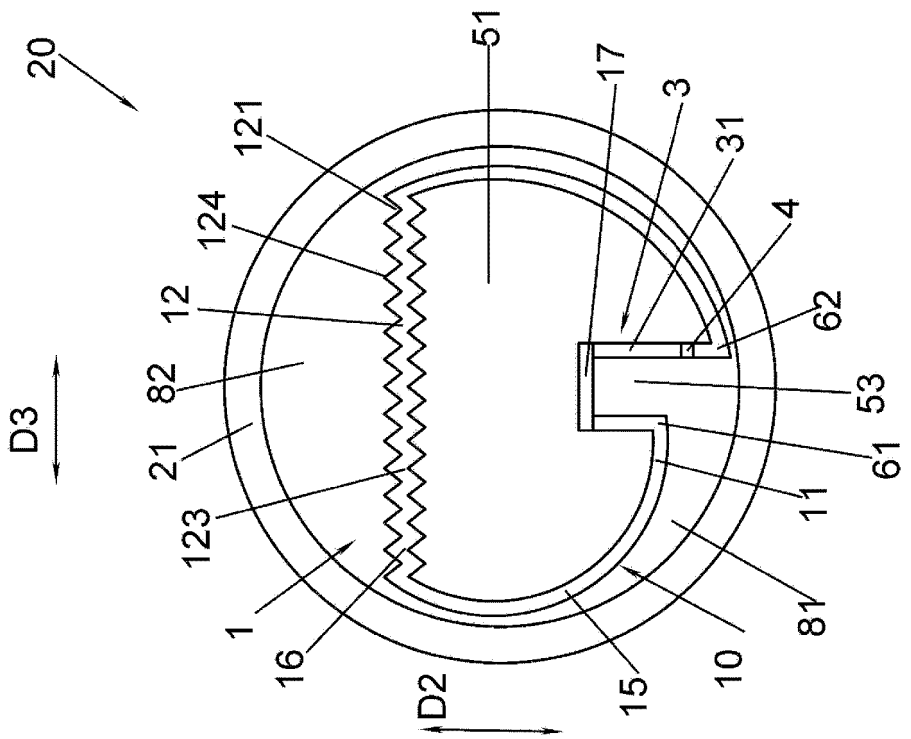
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Fig.6

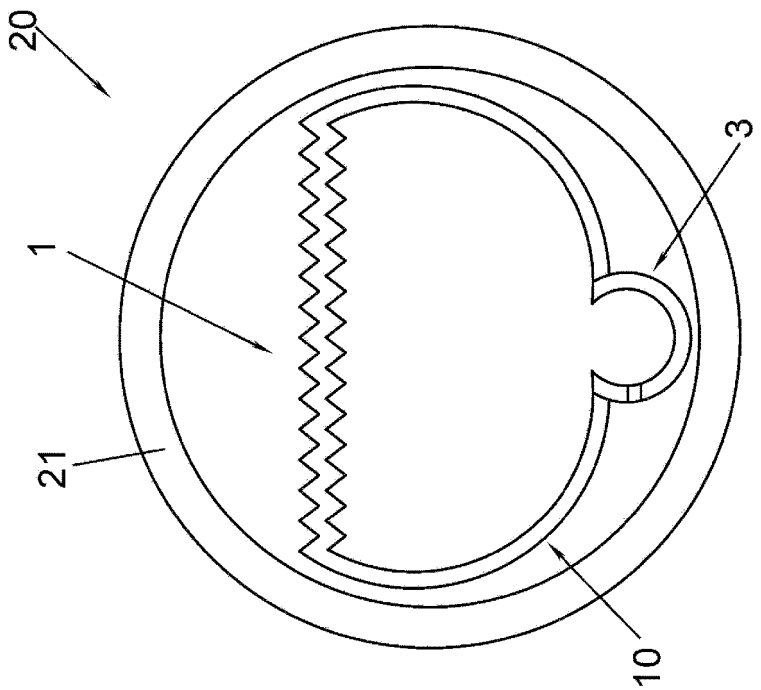
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Fig.5

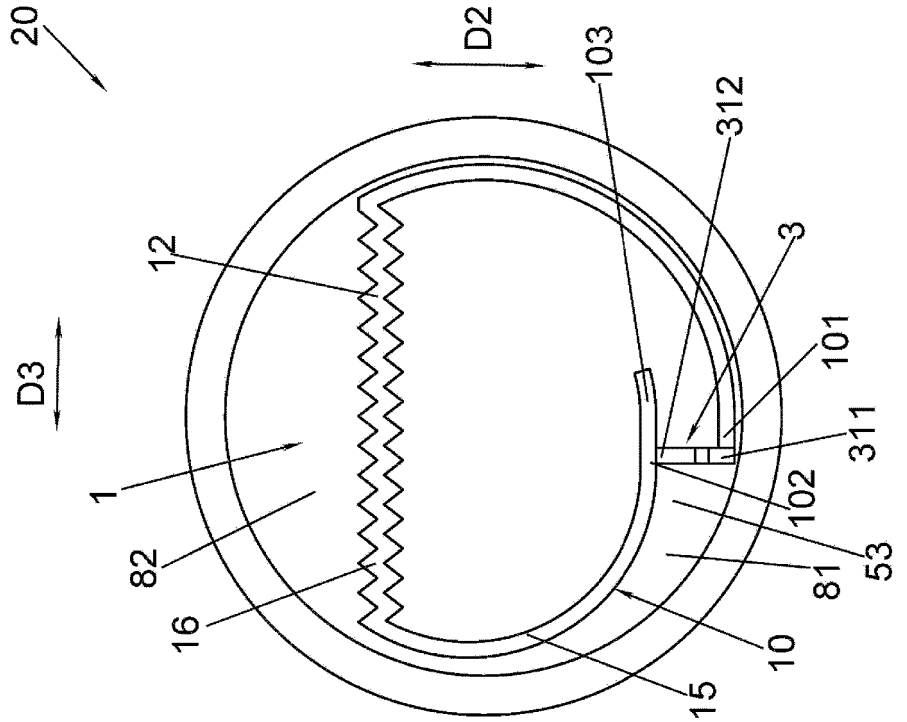
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Fig.8

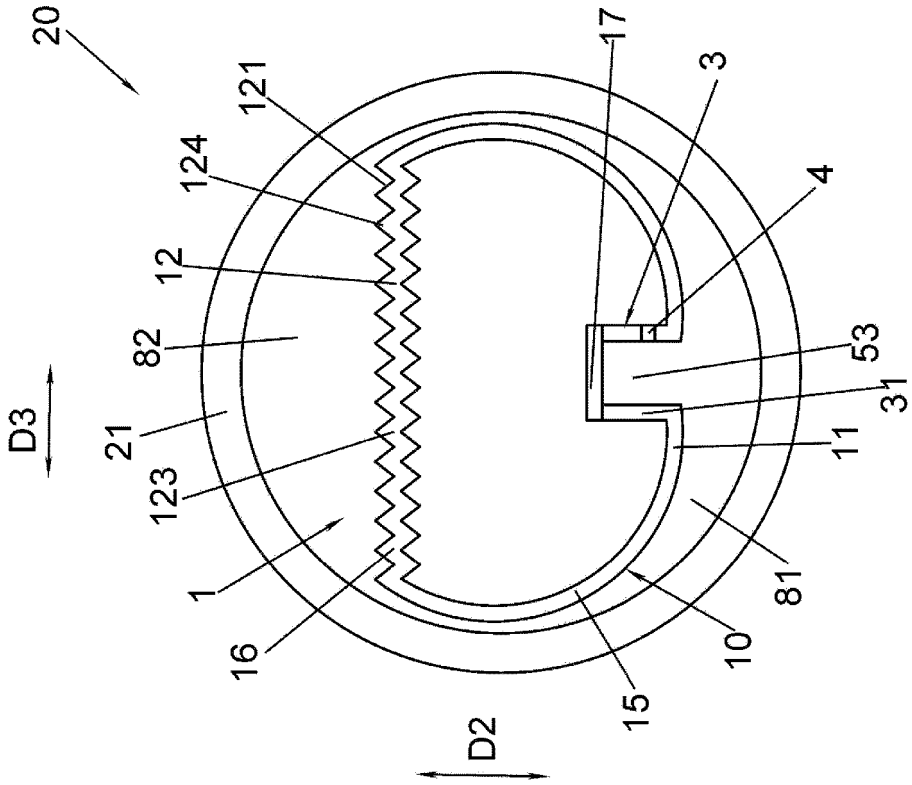
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Fig.7

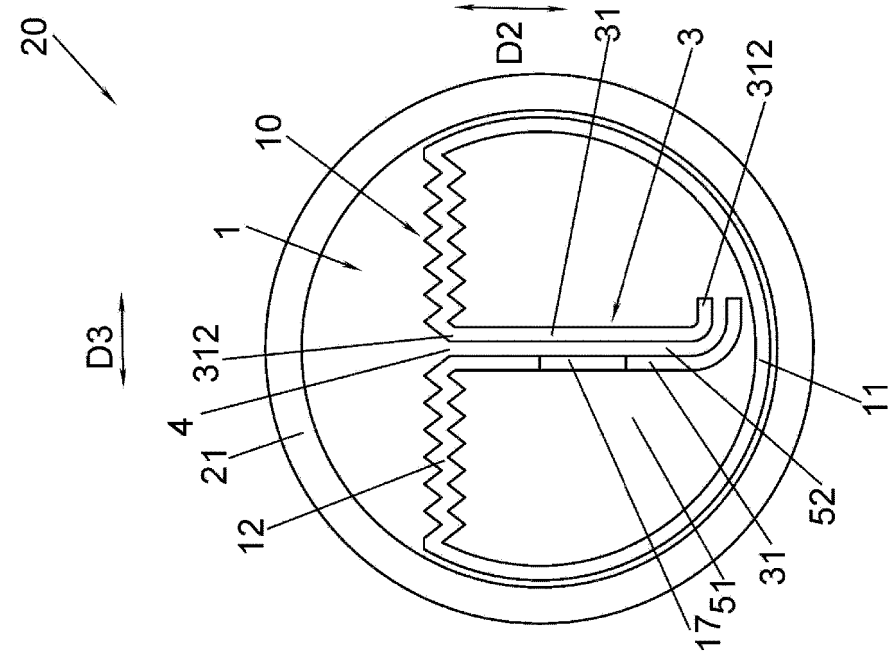
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Fig.10

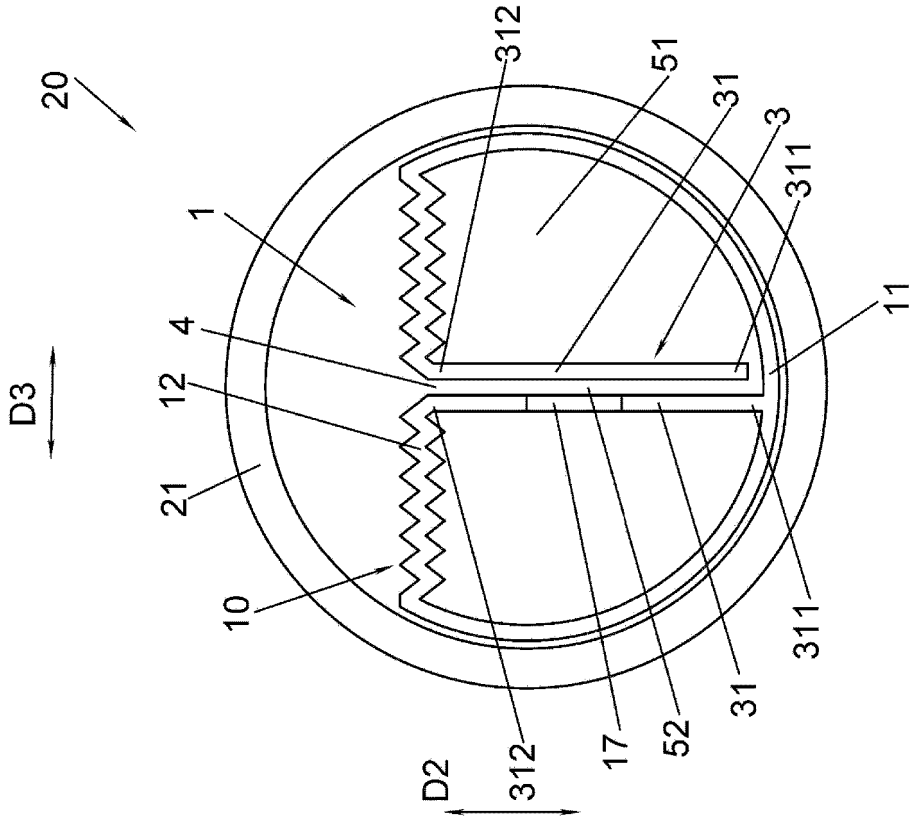
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Fig.9

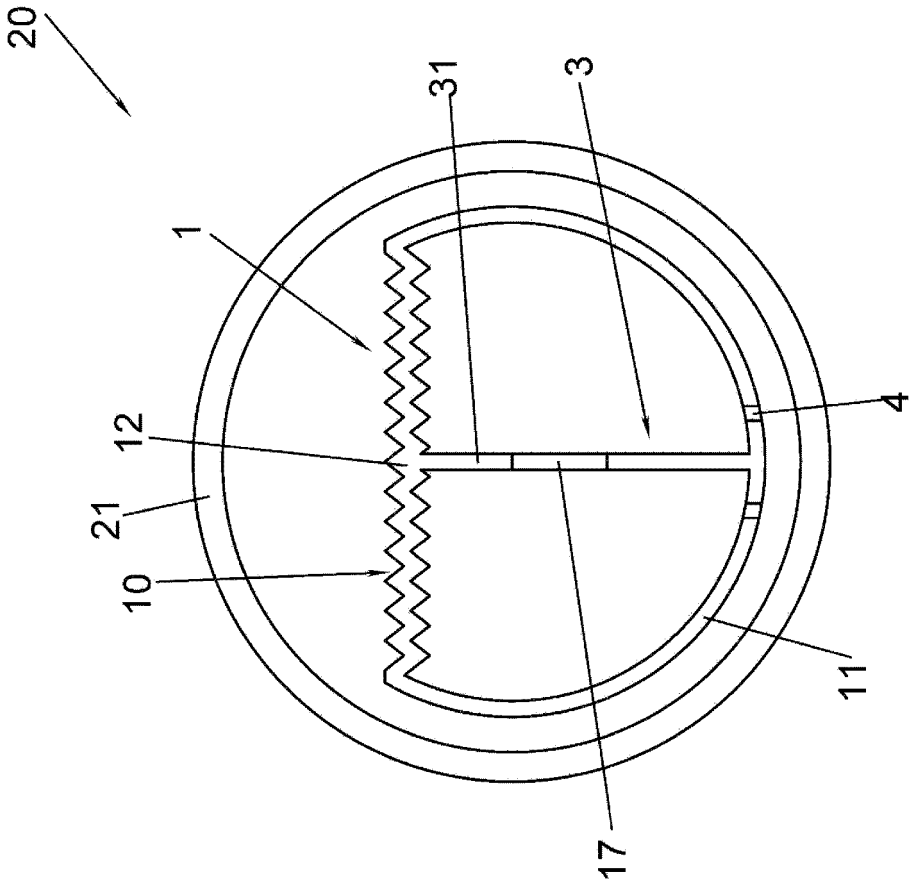

Fig.11

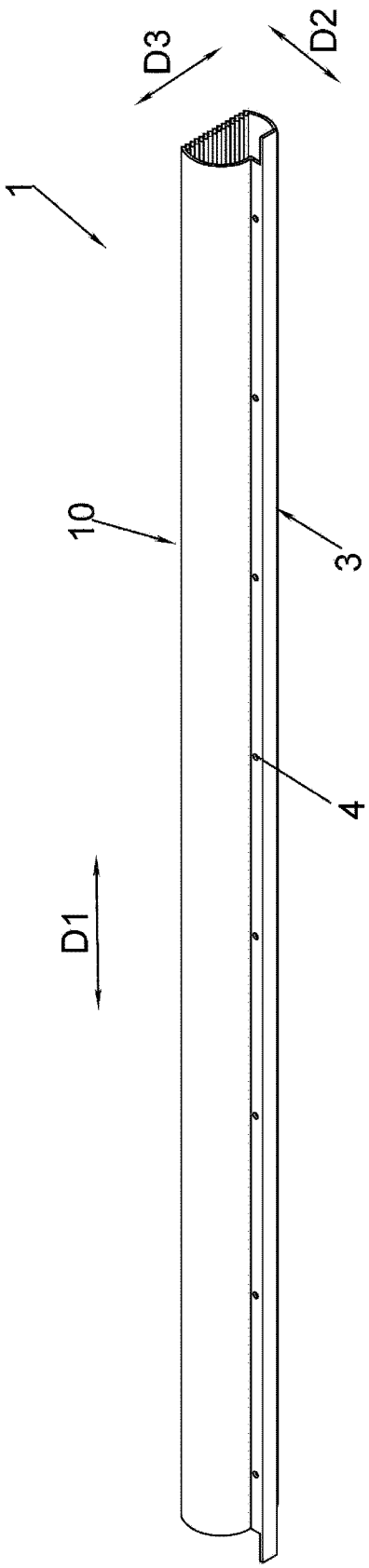

Fig.12

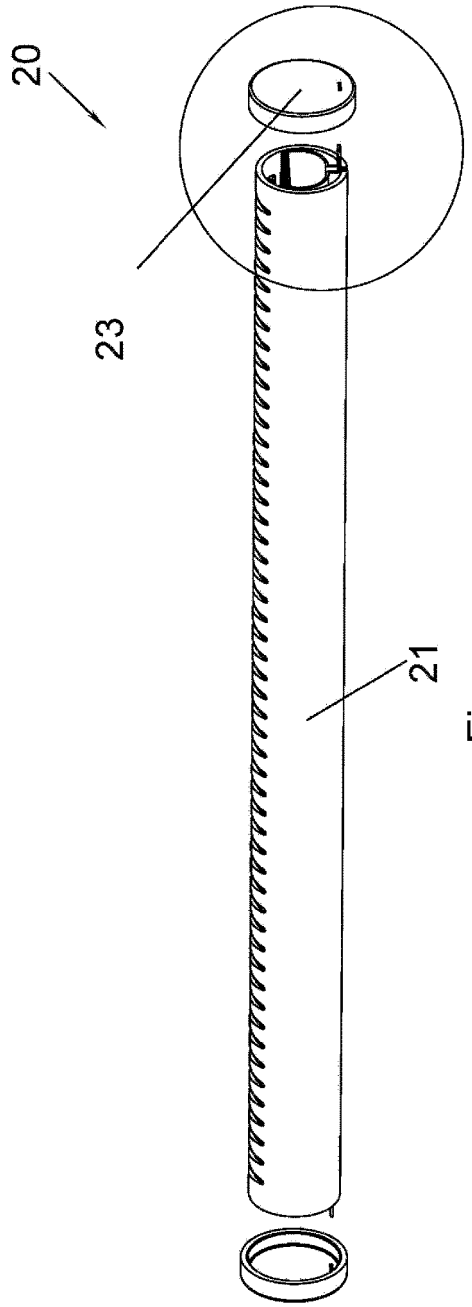

Fig.13

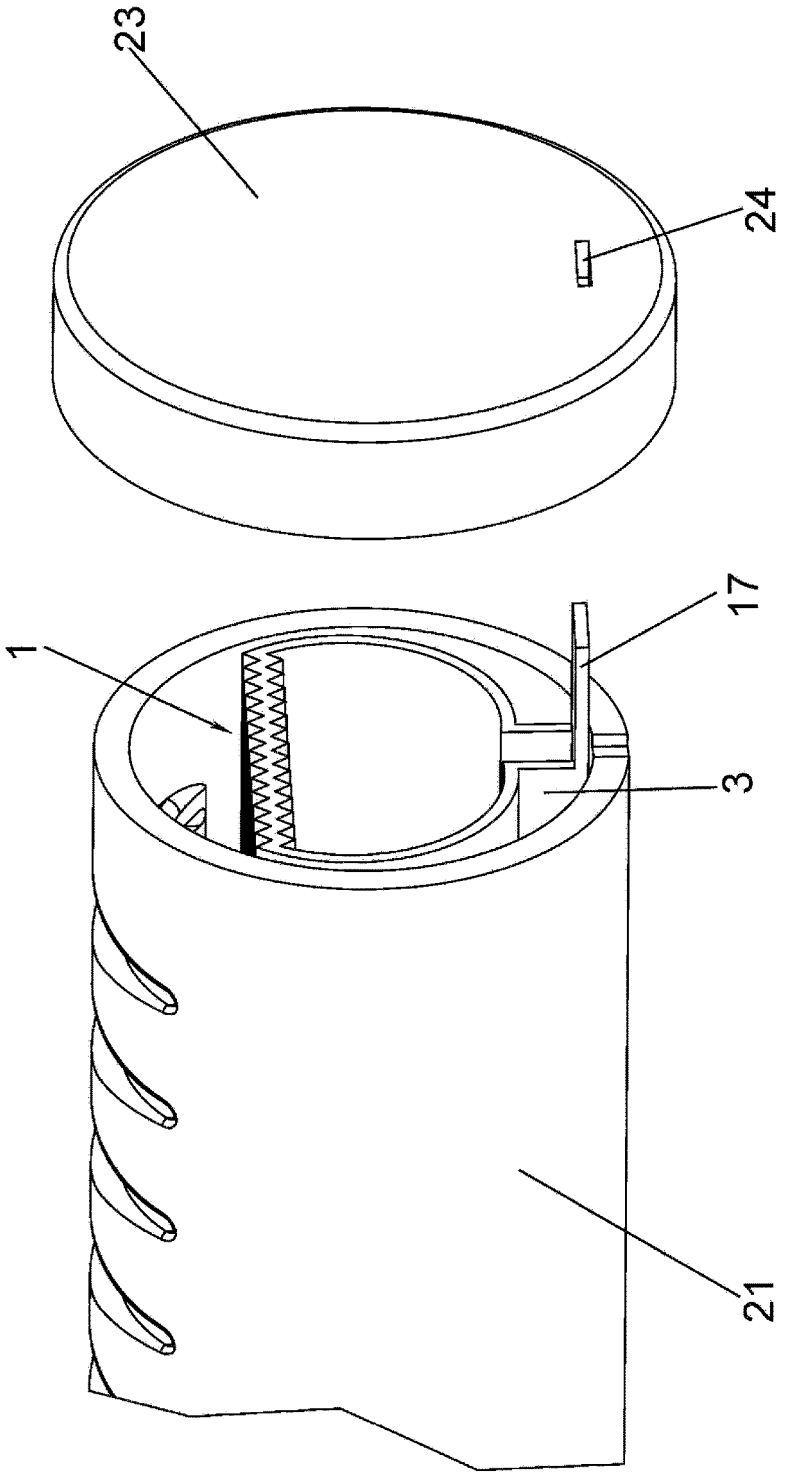

Fig.14

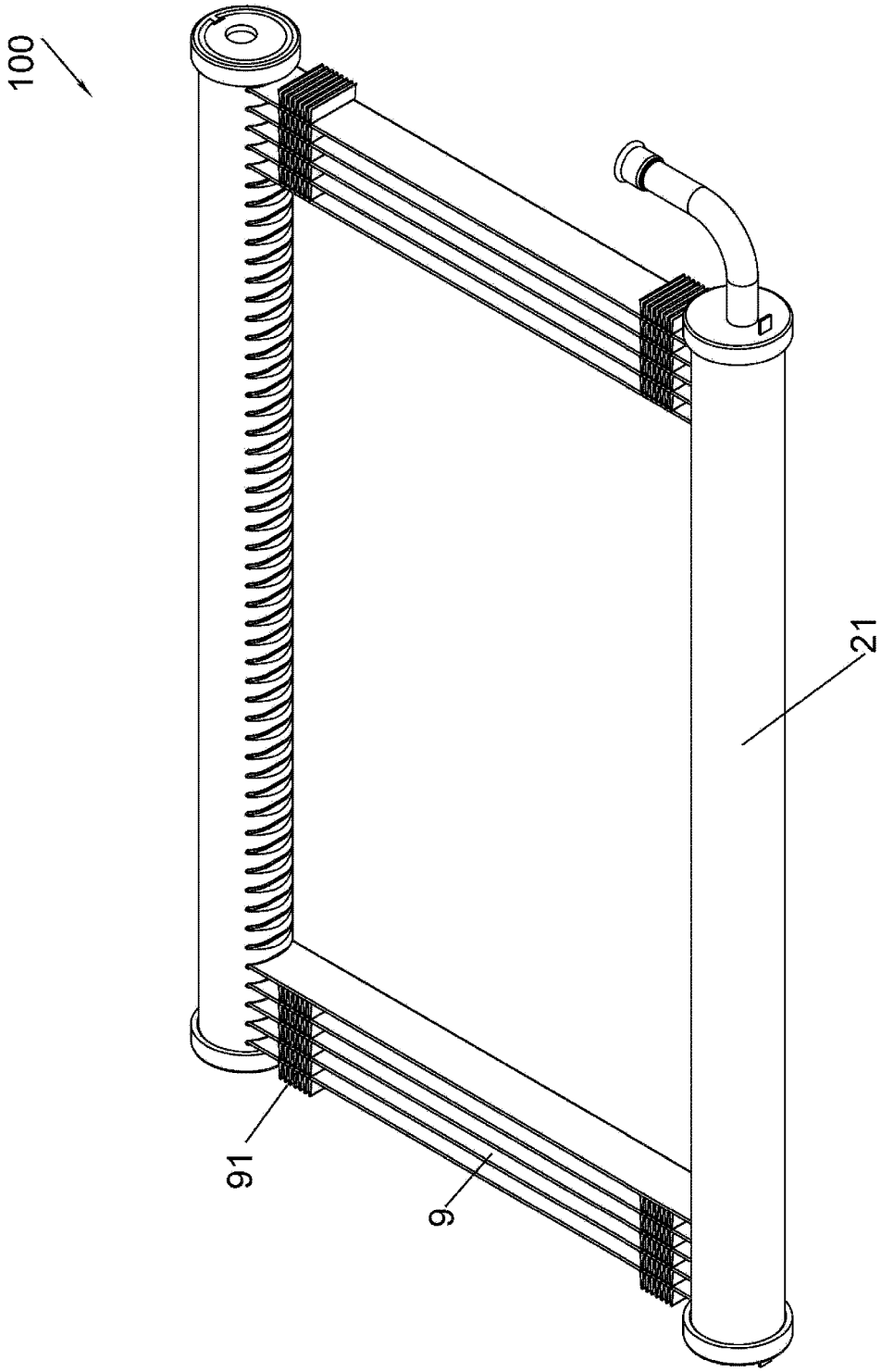

Fig.15

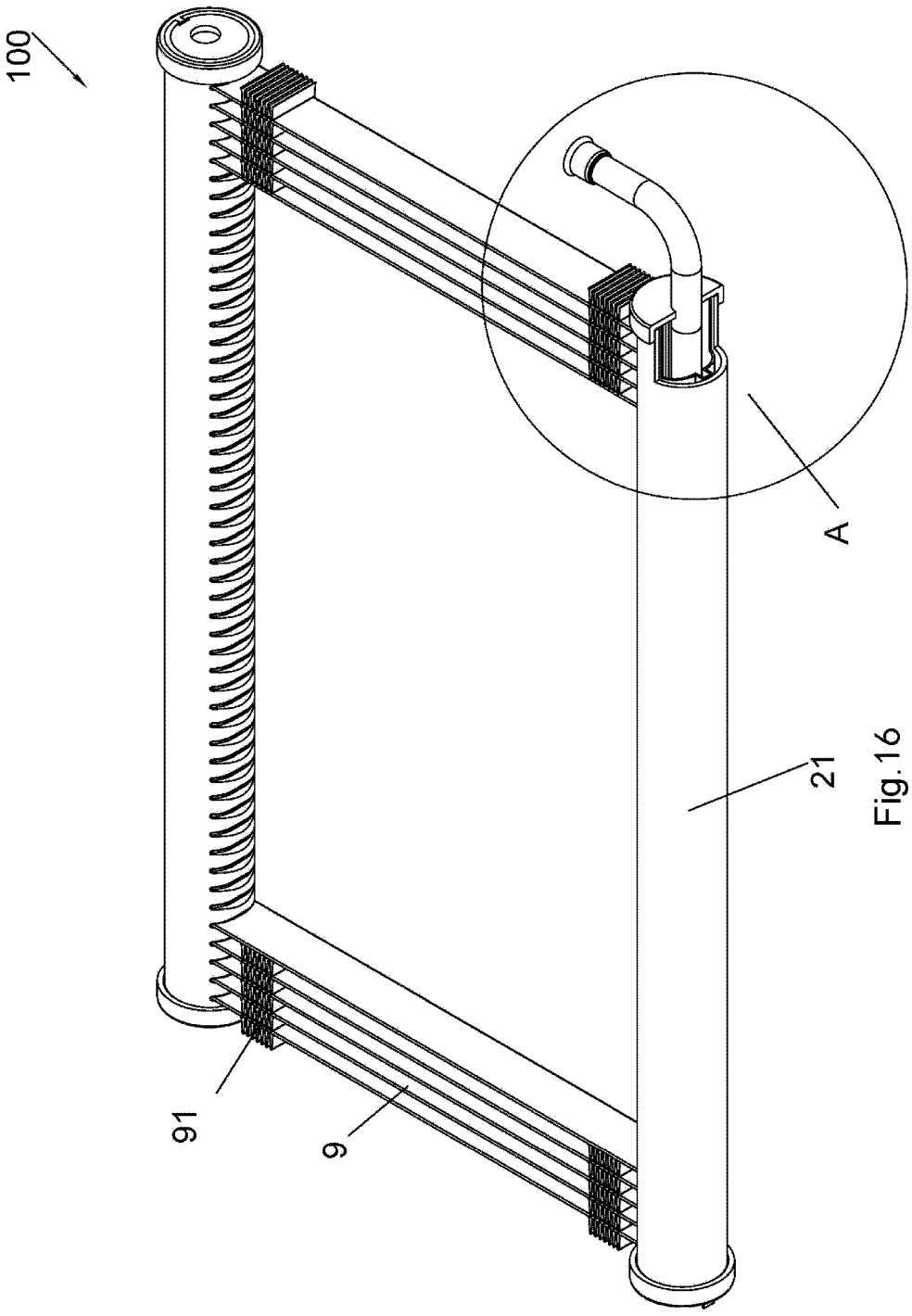

Fig.16

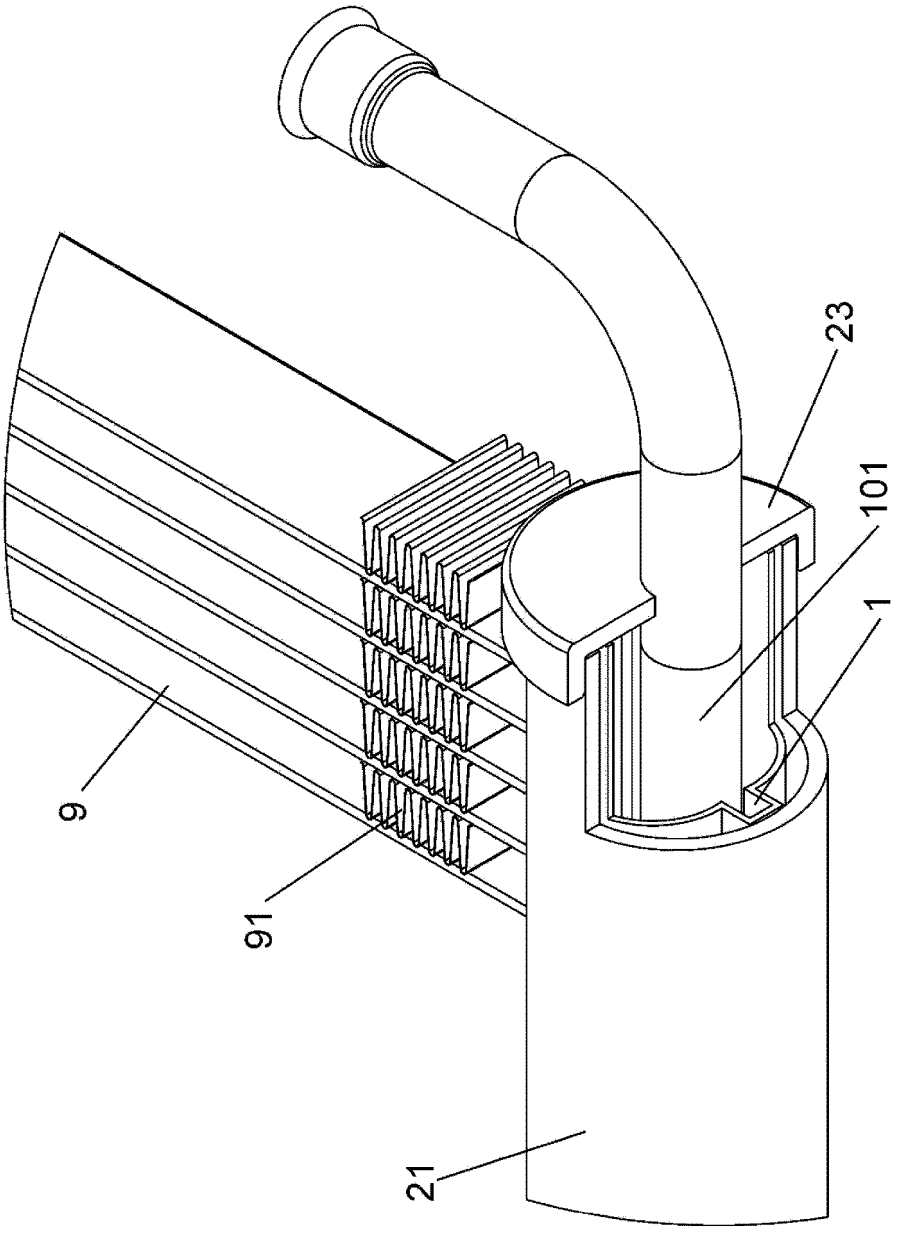

Fig.17

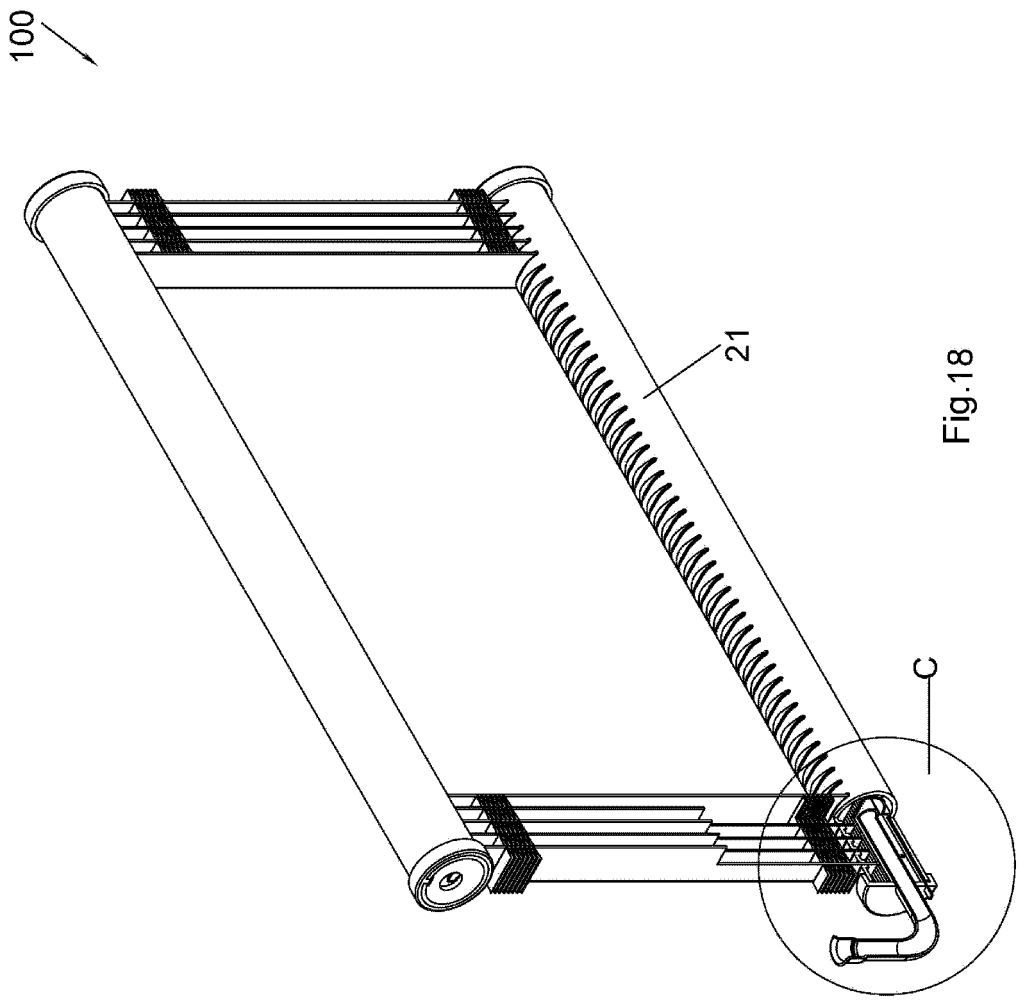

Fig.18

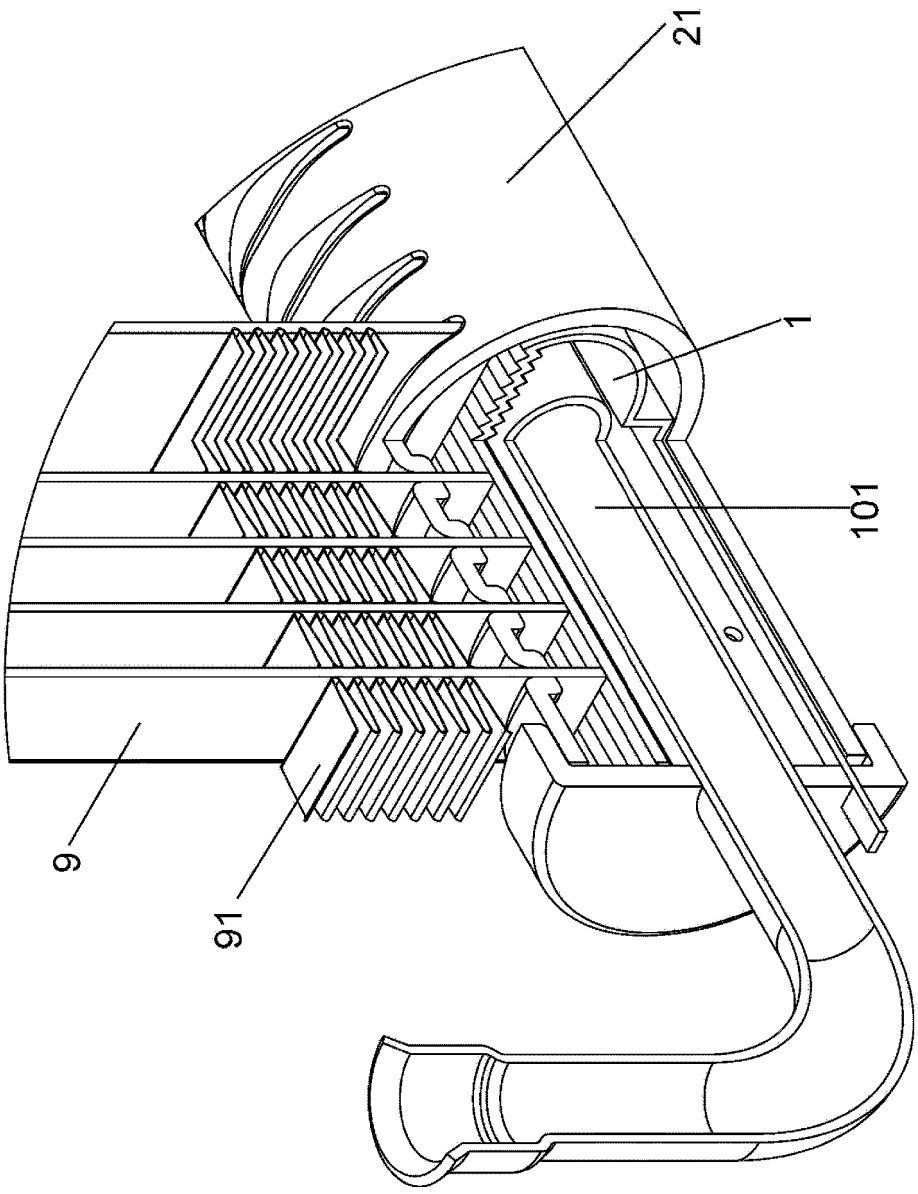

Fig.19

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/102271

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F28F9/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI, CNKI, CNABS, SIPOABS, CNTXT, USTXT: 丹佛斯, 金俊峰, 李艳星, 佩尔蒂埃, 邵明, 张锋, 李艳, 集管, 分配管, 壁, 孔; DANFOSS, DANA, collect+, header, distribut+, divid+, pip+, tub+, duct, wall, hole+, open+, notch+, orifice+, aperture+.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 209043106 U (DANFOSS AS) 28 June 2019 (2019-06-28) description, paragraphs [0050]-[0076], and figures 1-19	1-25
X Y	US 2010/0089559 A1 (CARRIER CORP.) 15 April 2010 (2010-04-15) description, paragraphs [0023]-[0033], and figures 1-6	1, 3-5, 18, 19, 21, 252, 6-17, 20, 22-24
Y	FR 3061283 A1 (VALEO SYSTEMES THERMIQUES) 29 June 2018 (2018-06-29) description, pp. 7-13, and figures 1-8	2, 6, 9-14, 17, 20
Y	US 2014/0202673 A1 (ALCOIL USA. LLC.) 24 July 2014 (2014-07-24) description, paragraphs [0054]-[0063], and figures 9-14	7, 8
Y	CN 104154801 A (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO., LTD.) 19 November 2014 (2014-11-19) description, paragraphs [0063] and [0064], and figures 13 and 14	15, 16
Y	CN 106871701 A (DANFOSS MICRO CHANNEL HEAT EXCHANGER JIAXING CO., LTD.) 20 June 2017 (2017-06-20) description, paragraphs [0066]-[0068], and figure 1	22-24

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 November 2019	**22 November 2019**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China**	
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/102271

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Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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